



# USFS Mission

"Caring for the Land and Serving People"

The mission of the USDA Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.

Our mission, as set forth by law, is to achieve quality land management under the sustainable multiple-use management concept to meet the diverse needs of people.

- ✓ *The Forest Service manages 155 National Forests and 20 National Grasslands.*
- ✓ *Total land equals 193 million acres in 44 States & other territories, representing nearly 30 percent of all federally-managed lands.*



# The Geospatial Management Office

The GMO provides a single organizational structure within the Washington Office to support all geospatial information program delivery in the Forest Service.

- The GMO is responsible for the policy, oversight, direction, and delivery of the Forest Service geospatial program, including geographic information systems (GIS), remote sensing, cartography, photogrammetry, geodesy, and global positioning systems (GPS).
- The GMO is positioned within the Washington Office - Engineering Staff.
- The GMO relies on the Geospatial Service and Technology Center (GSTC) and the Remote Sensing Applications Center (RSAC) to promote, facilitate, and support the application of geospatial technologies throughout the Forest Service.
- The Forest Service Geospatial Enterprise takes an “all lands” approach to remote sensing and mapping support.



# Components of the Geospatial Management Office

- **Geospatial Information Officer**

- Carl Zulick



- **Headquarters Program Leads**

- Remote Sensing- Everett Hinkley
- Geospatial Services- Betsy Kanalley
- GIS- Lisa McBride

- **Geospatial Service and Technology Center**

- Barry Napier, Director



- **Remote Sensing Applications Center**

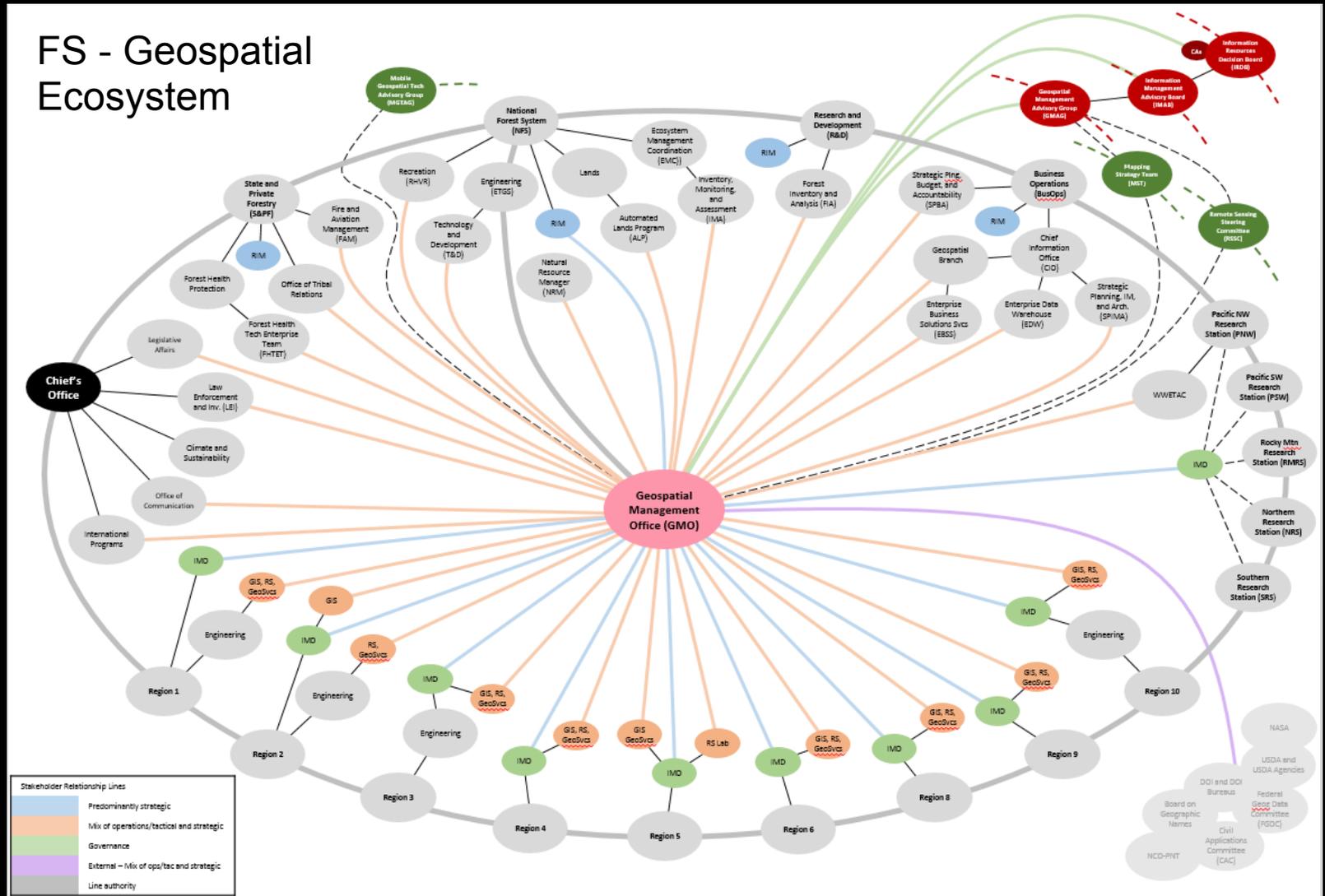
- Kevin Megown, Acting Director



# Forest Service – Geospatial Enterprise

## Staff Area Support

### FS - Geospatial Ecosystem



# The Geospatial Centers in Salt Lake City

The **Remote Sensing Applications Center** (RSAC) is a national technical service center of the USDA Forest Service. The mission of RSAC is to provide the Forest Service with the knowledge, tools, and technical services required to use remote sensing data to meet the agency's stewardship responsibilities. At RSAC, a structured program of work creates science-based information that supports the assessment and monitoring of natural resources.

The **Geospatial Service and Technology Center** (GSTC) provides a variety of geospatial services and products used daily by Forest Service field units, research offices, and WO Staffs, as well as other federal agencies, state, local, and tribal governments, private industry, academia, and the public. GSTC employs a uniquely skilled and equipped staff dedicated to providing a variety of geospatial services, from GIS data integration, analysis, and tools development, to web-enabled applications, data production and dissemination, cartographic publishing, technical assistance, and training.



# The National Remote Sensing Program

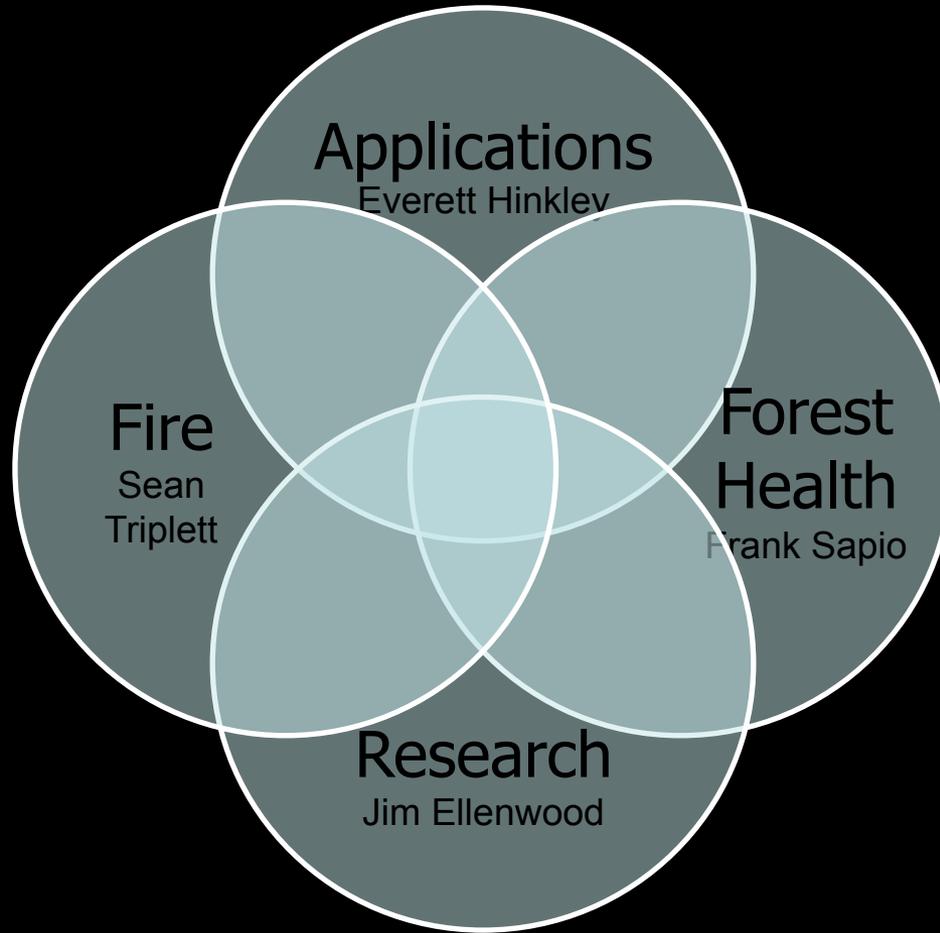
The National Remote Sensing Program provides critical subject matter expertise to a wide range of agency business areas including; Engineering, Fire & Aviation Management, Forest Health Protection, Research and Law Enforcement & Investigations.

The program provides remote sensing leadership and guidance to the Geospatial Management Office - Program Managers, Assistant Program Managers, and Geospatial Centers, as well as Forest Service regions and field units.



# Forest Service Remote Sensing

## The Bigger Picture



# Forest Service – Remote Sensing

## Staff Area Support

- **Wildland Fire Mapping Support** – detection, monitoring, mop-up
- **Forest Health Protection** – provide remote sensing support to forest health community.
  - Risk mapping
  - Aerial surveys
- **Research & Development – Jim Ellenwood**
  - Forest Inventory Analysis
- **Law Enforcement** – provide remote sensing support to aid in tactical level ground operations and cleanup issues.
- **International Programs** – provide support to other countries to aid in development of their remote sensing exploitation capabilities, based on our subject matter expertise.



# Technology Focus Areas

- **National Agricultural Imagery Program** – represent and coordinate FS needs
- **3D Elevation Program (3DEP)** - represent and coordinate FS needs. Look for partnering opportunities
- **Lidar** – continue to develop awareness and understanding of this technology across business areas.
- **Unmanned Aircraft Systems** – photogrammetric applications
- **Data sources** – continue to monitor all satellite and airborne sensor sources to insure best benefit to the Forest Service.
- **Sensors** – continue to work with NASA and others on needed sensor development.



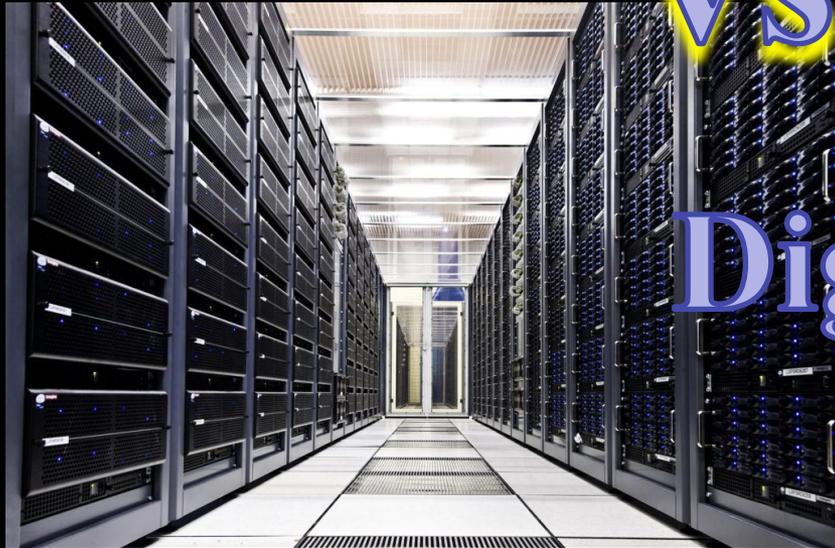
# Data Challenges

Analog



vs.

Digital



# NASA – Forest Service

## Joint Activities in Remote Sensing

- Tactical Fire Remote Sensing Advisory Committee
- Decadal Survey
- Arctic Boreal Vulnerability Experiment (ABOVE)
- Civil Applications Committee (CAC)
- Soil moisture applications
- Dr. Bruce Cook - working with Forest Service – Forest Inventory Analysis (FIA) Program and Hans Andersen in particular on FIA's operational implementation in interior Alaska. Dr. Cook is also Deputy Project Scientist for the G-LiHT airborne imager.
  - \* G-LiHT: Goddard's LiDAR, Hyperspectral & Thermal Imager



# Tactical Fire Remote Sensing Advisory Committee (TFRSAC)

**Mission:** Ensure that the NASA Wildfire Program is supporting the firefighter's technology needs. Identify "gaps & opportunities"; transfer capable technology and development applications to the Field.

**Co-Chairs:** Vince Ambrosia (NASA) & Everett Hinkley (Forest Service)

**Membership:** Stakeholders from NASA, USDA Forest Service, DOI Bureau of Land Management, Universities, and including Firefighters from 3 nations, with expertise in fire detection/mapping, aviation, communications, and ground operations.

**Successes:** Evaluation of Aircell system for national fire mapping aircraft, Unmanned aircraft systems evaluation for fire support/resource management, new sensor development to support fire, and others.



# Unmanned Aircraft Systems

## A menagerie of UAVs

As drones go domestic, both the models and the missions are multiplying.



### PREDATOR

Used by: DHS, NASA  
Used for: Border patrol and wildfire mapping.



### BAT

Used by: USDA  
Used for: Digital imagery to monitor rangeland vegetation.

### GLOBAL HAWK

Used by: NASA  
Used for: Tracking hurricanes and studying signs of climate change.



### DRAGON EYE

Used by: NASA  
Used for: Aerial mapping and in situ gas sampling.



### RAVEN

Used by: DOE, USGS, NASA  
Used for: Monitoring land change, wildfire mapping and general research.



### T-HAWK

Used by: USGS  
Used for: Monitoring Fukushima radiation emissions and environmental mapping.



# UAS Applications

- Wildfire
  - Near real-time, high resolution fire detection and characterization
  - Tactical scale imagery and geospatial mapping/visualization products
- Resource Management
  - General remote sensing – hi res imagery, LiDAR and others....
  - Forest inventory
  - Resource mapping (fuels, forest health, etc.)
  - Rangeland Monitoring (grazing permits)
- Law Enforcement & Investigations
  - Detection/mapping of illegal activities on Federal Lands
- Agriculture
  - Huge potential for mapping cropland
  - Other applications



# Forest Service UAS Strategy

- Augment, NOT replace, agency manned aircraft
- Work with partners to identify niche applications that are underserved by current technology
- Keep the approach simple; work on doing one thing well before adding additional capabilities
- Provide unified systems that are affordable



# UAS Interference

## Above spectacular wildfire on freeway rises new scourge: drones

By Michael Martinez, Paul Vercammen and Ben Brumfield, CNN

Updated 8:13 AM ET, Sun July 19, 2015



31 photos: California wildfires

Fires burn on a hill in Livermore, California, on Thursday, August 20. California has been battling numerous wildfires as its historic drought reaches a fourth year.

USDA  
United States Department of Agriculture

### IF YOU FLY, WE CAN'T

**DRONES NEAR WILDFIRES ARE NOT SAFE**

- FLYING DRONES OR UAS (UNMANNED AIRCRAFT SYSTEMS) WITHIN OR NEAR WILDFIRES WITHOUT PERMISSION COULD CAUSE INJURY OR DEATH TO FIREFIGHTERS AND HAMPER THEIR ABILITY TO PROTECT LIVES, PROPERTY, AND NATURAL/CULTURAL RESOURCES.
- FIRE MANAGERS MAY SUSPEND AERIAL FIREFIGHTING UNTIL UNAUTHORIZED UAS LEAVE THE AREA, ALLOWING WILDFIRE TO GROW LARGER.
- CONTACT YOUR NEAREST LAND MANAGEMENT AGENCY OFFICE TO LEARN MORE ABOUT UAS AND PUBLIC LANDS.

Forest Service



# Lidar: Light Detection And Ranging

## Questions to consider:

- What is Lidar?
- What makes lidar unique?
- Are all lidar data of equal quality?
- What is the status of lidar in the FS?
- Partnering opportunities and issues...

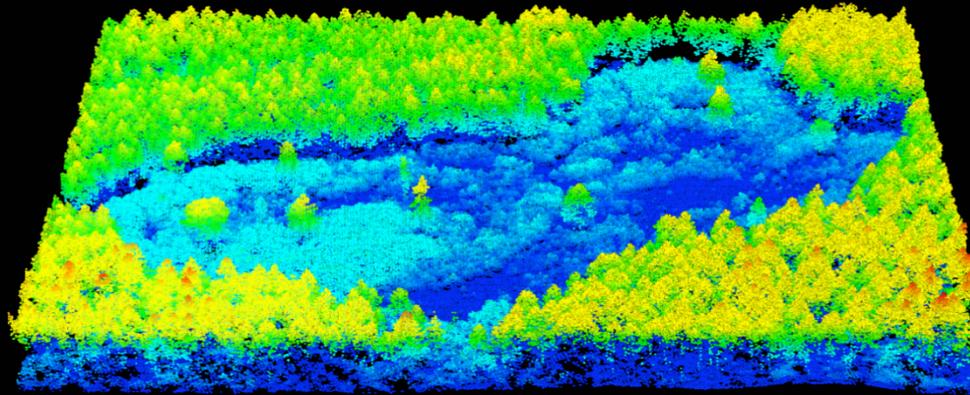
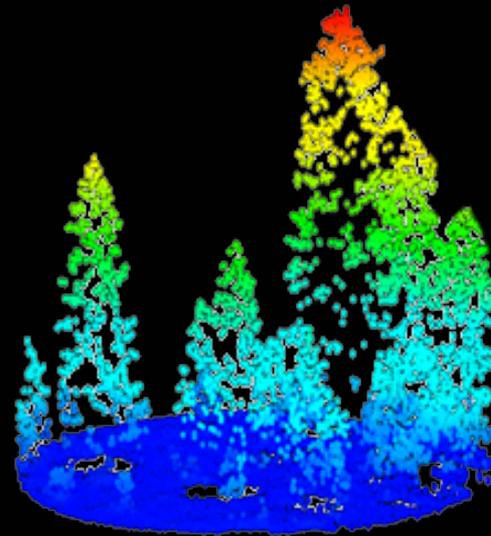


Figure 1: a color-coded (by height) LIDAR image.

# LIDAR Data: 3D Point Cloud

Each point is very precisely located in 3D (X,Y and Z)

Lidar provides one way to accurately tree height, canopy cover, and perhaps even tree species over large areas



**Figure 3:** LIDAR 3D point cloud representing the spatial arrangement of conifer trees on a circular plot.

# LIDAR Use in Forest Service

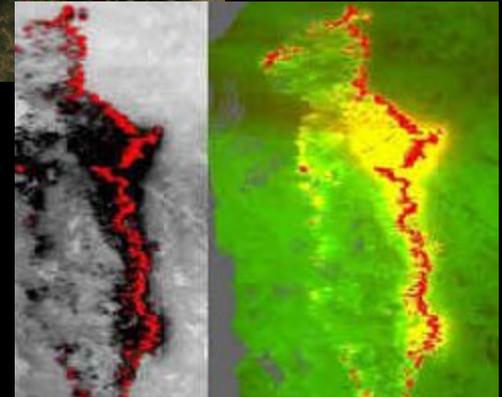
LIDAR plays an important role for the Forest Service in two categories: vegetation classification and mapping and topographic analysis: Some important applications include:

- Vegetation Mapping
  - Forest inventories
  - Wildland Fuel Assessments
  - Wildlife habitat assessments
  - Monitoring canopy change
- Topographic Mapping
  - Engineering
  - Floodplain – watershed mapping and flood risk assessment
  - Landslide hazard assessment
  - Stream channel mapping Geological mapping

# Remote Sensing - Sensors

- **Satellite**

- MODIS
- VIIRS
- GOES
- AVHRR
- *Landsat*
- *Other*



- **Airborne**

- Phoenix
- Lodestar wide area imaging system
- Cloud Cap Tase Duo EO/IR gimbal unit
- FLIR Gimbal

- **Other**

- Hawkeye / fire detection & reporting
- Firehawk / active fire mapping



# Wildland Fires - Requirements

## What Information is Needed?

- **Initial Fire detection and reporting** / where are the starts?
- **Fuel information** – what is available to burn?
- **Weather** - what are the current and predicted conditions?
  - Need good forecasting
  - And real time, high granularity **weather information** during event.
- **Where is the active fire / what is the behavior?**
  - Active fire front location and progression
  - Fire intensity/energy release
  - Fire perimeter extent
  - Where the fire has been (the black)
  - Lines of containment
- **Where are the assets at risk? The people at risk?**
- **What is the terrain in the area of operations?**

**Update frequency? Data accuracy?**

**Real-time or near real-time highly desired!**



# Wildland Fires – RS Technology

## Platforms

- Satellites
- Manned aircraft – fixed wing, helicopters
- Unmanned aircraft

## Sensors

- Thermal Sensors
- EO and Night Vision
- Weather Sensors

## Data Telemetry Capabilities

- Aircell Internet capability
- UAS radio repeaters
- Quad Wave Relay Radio

**Decision Support Tools** – Intelligent mission management technologies which take in data, analyze and then display the appropriate data to decision makers.



# Aircraft

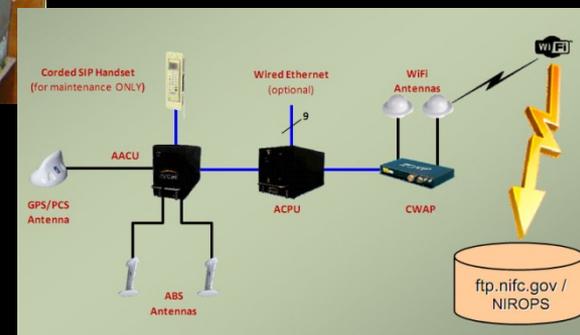
- National Infrared Operations
  - Two fixed-wing aircraft equipped with Phoenix line scanners.
    - Operate at night flying fire perimeters and producing maps for the next operational period.
- Fire Watch helicopters
  - Two AH-1 Cobras equipped with FLIR and local downlink and mapping technology.
- Vendor Aircraft & Military
  - Qualified vendors available on call-up



# Tactical NRT Wildfire Observations

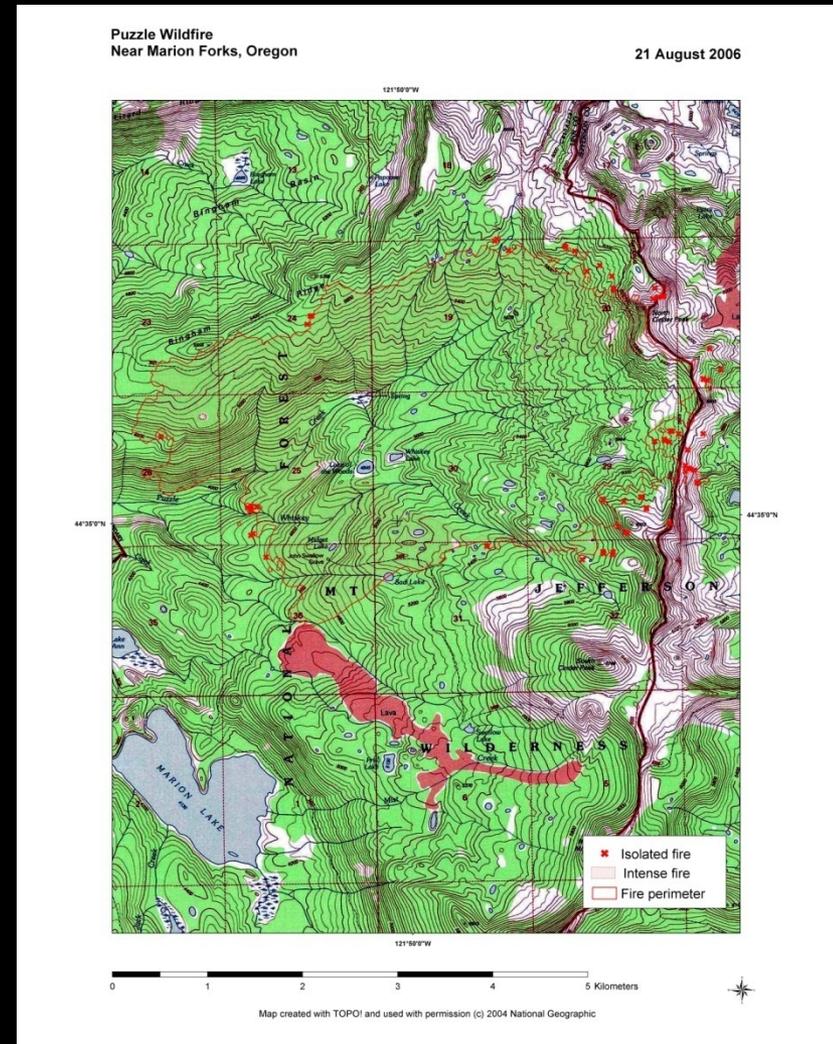
## NIFC National Infrared Operations

- The National Interagency Fire Center (NIFC) operates two aircraft for nationwide fire sensor imaging support:
  - Cessna Citation Jet
  - Beechcraft B200 King Air
- The Phoenix dual channel TIR imaging system operates on both aircraft;
- Near Real-Time data through Aircell Mobile Broadband Network Aircraft-to-ground telemetry package allow data transmittance anywhere in US.
- Large scale tactical fire detection/mapping to support incident command operations
- Continuous operational deployment since 1967



# Firehawk Active Fire Mapping

- Cooperative work over many years with the National Geospatial-Intelligence Agency and other intel agencies has resulted in a quality, field-accepted product
- Work began in 1994
- “National Technical Means” only used as a “gap filler” when other fire mapping assets are exhausted
- Typically used at higher planning levels (PL4, PL5)
  - Asset has been utilized at PL2, 3
    - E.g., Alaska, Southern CA



# Hawkeye – Fire Detection & Alerting

- Through the Ignition Point Database, any source of fire detection data can be funneled
- 2012 to 2014 – Experiments were conducted, policy enacted and plumbing completed
  - Demonstrated a fire alert capability together with rapid reporting
  - Fire alerts have a low false alarm rate
  - All forensic case studies were very positive for system fire alerts
- 2015 – First year of full distribution to the Enhanced Geospatial Portal (decision support tool)
- Future capability will eliminate “man-in-the-loop”, and provide enhanced false alarm de-confliction through fusion of multiple sources
- Will likely evolve into full active fire support



# Active Fire Mapping Program

(<http://activefiremaps.fs.fed.us>)

- Satellite detection and monitoring of wildfire activity in CONUS, Alaska, Hawaii & Canada
- Leverages NASA and NOAA assets
  - MODIS
  - GOES
  - AVHRR
  - VIIRS
- Facilitates decision support for strategic planning & response for U.S. and Canadian fire agencies
  - Prioritize allocation of fire suppression assets
  - Integrated into fire-related applications and decision support systems
- Developing new capabilities
  - Early detection
  - Spatially refined data



# RSAC X-Band Direct Readout Ground Station

## Location:

- Salt Lake City, Utah;  $111.949^{\circ}$  W  $40.722^{\circ}$  N

## History:

- MODIS direct broadcast data collection since 2002
- VIIRS direct broadcast data collection since 2012

## Antenna:

- 2.4 meter X-band antenna; 3-axis SeaTel Model 9497A-7
- Radome enclosure



# Enterprise Geospatial Portal (EGP): Near Real-Time Aircraft Intel Integration

The image displays two screenshots of the Enterprise Geospatial Portal (EGP) interface, illustrating the integration of near real-time aircraft intelligence.

The top-left screenshot shows a mobile interface with a sidebar menu for "Aircraft Intel". The menu includes options like "Select a Mission", "Status: Inactive", "Refresh", "Zoom to Mission", "Show Products", "Auto Update", and "Advanced View". The main view shows a map with a red box highlighting a specific area.

The top-right screenshot shows a mobile interface with a sidebar menu for "Aircraft Intel". The menu includes options like "Aircraft", "Hot Spots", "Retardant", "Fire Lines", "Perimeters", and "Imagery". The main view shows a map with a red box highlighting a specific area.

The bottom-left screenshot shows a desktop interface with a "layers" panel on the left, a map view, and a "Current Mission" panel on the right. The "Current Mission" panel includes options like "Hotspots", "AFL", "Perimeter", "Retardants", and "Aircraft". The "Imagery Products" panel includes a table of products:

| File Name                        | View |
|----------------------------------|------|
| MMA01 1029201417152 EO 180655183 | Load |
| MMA01 1029201417152 IR 180514959 | Load |
| MMA01 1029201417152 IR 180949186 | Load |

- Near Real-time visualization of products and missions from aircraft
- Ability to integrate new sensors/systems (API-based)
- Viewable across all EGP systems and users (mobile to desktop)
- Links remote sensing data with Incident and Resource information



# Opportunities Ahead

**Climate Change** - The Office of Sustainability and Climate Change Director is the primary spokesperson for the Forest Service on climate change and leads the implementation of the nationwide strategy for weaving climate change and sustainability response into policies, processes, and partnerships.

**Urban Forestry** - the careful care and management of tree populations in urban settings for the purpose of improving the urban environment. Urban forestry advocates the role of trees as a critical part of the urban infrastructure.

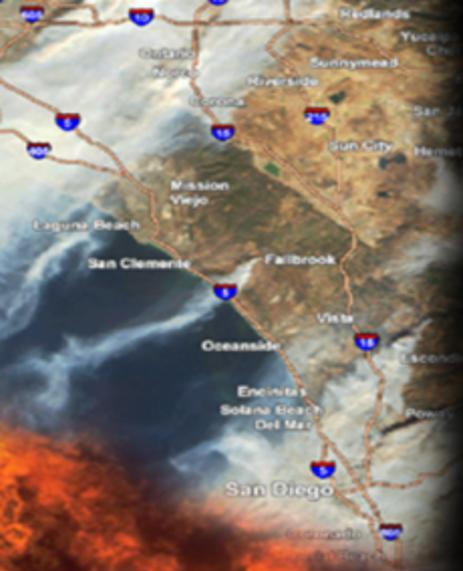


# In Closing

**All Lands Approach**- The Geospatial Management Office and the National Remote Sensing Program view geospatial support to the Forest Service from an “all lands” approach. Forested lands in the United States total 800 million acres of which 193 million acres are actively managed by the Forest Service.

**NASA – Forest Service Interaction** - the Forest Service and NASA must continue our engagement and collaboration in both applications and research, leveraging NASA expertise in Earth Observing Systems to bridge FS information gaps.





## Speaker Contact Information:

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